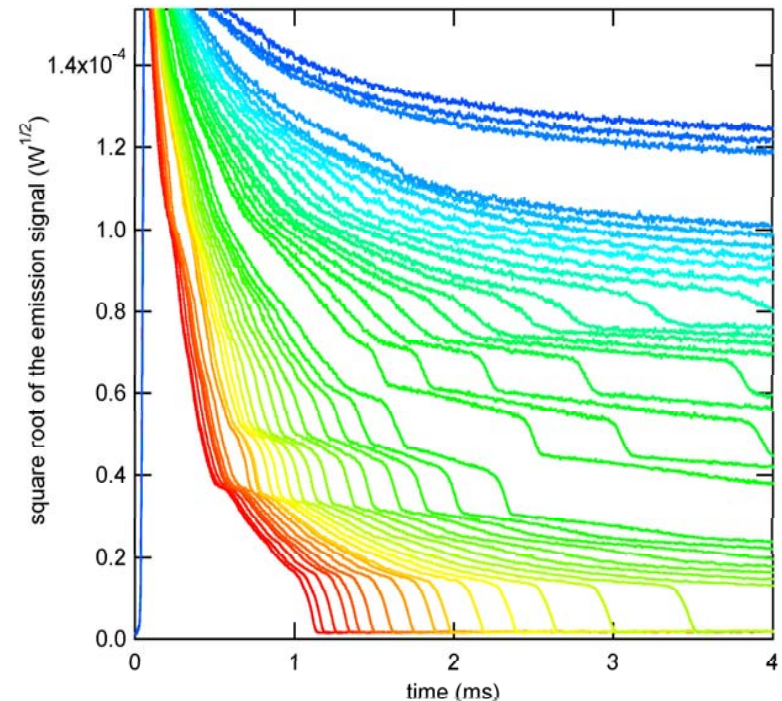


Experimental studies of nanoscale energy localization in periodic condensed matter systems

A. J. Sievers, LASSP, Cornell University, DMR-0301035

Unexpected power steps have been observed when the number of intrinsic localized modes (ILMs) is varied in a nonlinear atomic lattice. A nonlinear energy magnetometer is used to produce locked ILMs in an antiferromagnet, and then to measure the power emitted by the sample versus time. When ILMs disappear steps in power can be counted. These steps are remarkably constant, almost independent of the initial conditions and indicate that the ILM energy is quantized. Our experiments address a long-standing question regarding classical versus non-classical behavior of nonlinear energy localization at nanoscale lengths.



A family of nearly equal size discrete ILM emission steps is observed in a nonlinear atomic system. In this four wave mixing experiment blue corresponds to high input power and red to low power.

The manipulation of electric current through mesoscale systems (1 to 1000 nm, where the human hair is 150000 nm) is the backbone of computer design. Less well understood is how to manipulate energy (or heat) over a similar length scale. This group has demonstrated that mesoscale hot spots can be produced and individual ones counted in an atomic lattice. These experiments represent the first step along a path where future applications might lead to directed energy transfer, smart materials, and nano-heat engines.

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Education:

One undergraduate (Sean Casey), four graduate students (Bruce Hubbard, Jonathan Wrubel, Molly Golladay and Patrick Alken), and two postdocs (N. Agladze and M. Sato) contributed to this research.

Outreach:

Fig. 1- Bruce helps under-represented middle school children from the local school districts to learn about the telegraph and Morse code.

Fig. 2- Jonathan works with a local K-teacher to improve “waterplay” activities.

"Ask a Scientist" article for the Ithaca Journal.
The PI organized and co-directed a NATO Advanced Research Workshop on “Intrinsic Localized Modes and Discrete Breathers” at Erice, Sicily.

